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A COMPREHENSIVE PROGRAM FOR WATER POLLUTION CONTROL FOR THE MISSISSIPPI-WAPSIPINICON AND TRIBUTARIES RIVERS BASIN DEVELOPED BY THE STATE WATER POLLUTION CONTROL AGENCIES, OF ILLINOIS, IOWA, MINNESOTA, AND WISCONSIN

Public Health Service
Cincinnati, Ohio

1953

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Water Pollution Series No. 62

A COMPREHENSIVE PROGRAM FOR WATER POLLUTION CONTROL

for the

MISSISSIPPI-WAPSIPINICON & TRIBUTARIES RIVERS BASIN

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A COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM

for the

MISSISSIPPI-WAPSIPINICON & TRIBUTARIES RIVERS BASIN

Developed by the State Water Pollution Control Agencies
of
ILLINOIS, IOWA, MINNESOTA, and WISCONSIN

1953

Adopted by

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
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FOREWORD

Our country's development over the past 50 years has been marked by tremendous progress in many fields. It has made possible great gains in the health, comfort, and well-being of the people. But it has not been without cost. Part of the cost has been the damage to the Nation's water resources that has resulted from wastes discharged to the streams by our growing cities and industries. All water uses have been affected--public water supplies, recreation, agriculture, industry, fish and aquatic life.

In enacting the Federal Water Pollution Control Act in 1948, the Congress declared that "water pollution has become a matter of grave concern in many areas and its damaging effects on the public health and national resources are a matter of definite Federal concern as a menace to national welfare. Abatement must be undertaken in order to control it."

The Public Health Service, as part of its responsibilities under this Act, is required to prepare or adopt, in cooperation with other Federal agencies, State and interstate water pollution control agencies, and municipalities, and industries, comprehensive programs for the abatement of pollution.

This report contains the comprehensive water pollution control program for the Mississippi-Wapsipinicon & Tributaries Rivers Basin of the Iowa State Department of Health, Illinois Sanitary Water Board, Minnesota State Department of Health, and the Wisconsin Committee on Water Pollution. The program is sound and gives full consideration to the several present uses and to the reasonably-anticipated future uses of the waters of this basin. It provides an equitable balance in the pollution control requirements for various private and public groups concerned.

I am pleased, therefore, in my capacity as Surgeon General of the Public Health Service, to adopt the program developed by the State water pollution control agencies of Iowa, Illinois, Minnesota, and Wisconsin for the Mississippi-Wapsipinicon & Tributaries Rivers Basin as a comprehensive program which fully meets the requirements of the Federal Water Pollution Control Act.

This program is based on beneficial water uses and related conditions that prevailed on July 1, 1953. Comprehensive programs for pollution control must necessarily be flexible. They must allow for growth, development, and changing conditions. Any significant changes affecting water quality, such as stream flow, water use, industrial development, population, etc., may require changes in the pollution control program.

Obviously the mere adoption of this program will not, in itself, reduce pollution or improve the usefulness of the waters in this basin. It does provide to the citizens of the area and to the city officials and industrial leaders, farmers, fishermen, conservationists, and others an objective plan based on good engineering practice, and reflecting sound economics. It is a plan which the public can support, and must support, if progress is to be made in the abatement of pollution.

Certain additional considerations beyond the mere acceptance of a plan are essential to its successful execution. The citizens of the areas affected must see that sufficient resources are provided to the State water pollution control agencies concerned to enable them to make the technical investigations to aid those responsible for constructing pollution abatement works.

We must recognize, too, that in order to be fully effective the plans and programs of one State must be geared closely to those of adjoining States, since State boundaries are no barrier to pollution traveling in interstate streams. Above all, no program of this nature can progress beyond the report stage if its meaning and purpose are not made clear and understandable to the citizens of the area. In the final analysis they are the ones who will pay, directly or indirectly, for the pollution abatement works that are needed.

It is my hope that this program for the Mississippi-Wapsipinicon & Tributaries Rivers Basin will be carried through to completion so that the area may enjoy all the benefits that clean water can provide, in health and recreational opportunities for the people and in sound growth of industry and agriculture.

Leonard A. Scheele

Leonard A. Scheele
Surgeon General

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INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June, 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies, and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

This report, prepared in cooperation with the water pollution control agencies of Iowa, Illinois, Minnesota, and Wisconsin, sets forth the water pollution control program being followed by the respective States in the Mississippi-Wapsipinicon and Tributaries Rivers Basin. This program, which is based on data available as of July 1, 1953, was developed after a thorough consideration of the existing and potential uses of the water resources in the basin; the pollution entering the streams and the resulting damages; the benefits which may result from pollution prevention and abatement; and the prevention measures now in effect as well as those which are needed.

Agencies which cooperated in the preparation of this report included the Iowa State Department of Health, Illinois Sanitary Water Board, Minnesota State Department of Health, and Wisconsin Committee on Water Pollution. Acknowledgment is made to the Corps of Engineers, Department of the Army; Soil Conservation Service, and Forest Service, Department of Agriculture; Bureau of Census, Department of Commerce, Bureau of Mines, Fish and Wildlife Service, and Geological Survey, Department of the Interior; and the Federal Power Commission for their review of the report and for the information obtained from their published reports. Acknowledgment is also made of information obtained from the report of the Committee on Water Resources, Iowa State Planning Board.

Part One

COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM
FOR THE
MISSISSIPPI-WAPSIPINICON AND TRIBUTARIES RIVERS BASIN

GENERAL CHARACTERISTICS AND ECONOMIC DEVELOPMENT

The Mississippi-Wapsipinicon and Tributaries Rivers Basin lies for the most part in northeastern Iowa with 25 per cent of the basin about equally divided between Illinois and Wisconsin. Less than one per cent of the area is in Minnesota. The basin comprises 9,530 square miles of the Mississippi River watershed and is drained by the Wapsipinicon, Maquoketa, and Turkey Rivers which discharge into the Mississippi River above Davenport, Iowa.

The upper part of the basin has a rolling and hilly topography. Near the Mississippi River the terrain becomes rugged and the streams have fairly steep slopes. Little or no flow regulation exists in the basin since there are only a few small natural or impounded lakes in the headwaters region. Extreme low flows are experienced during the late summer and early fall periods, as well as during the midwinter period.

Climate of the basin is temperate. Monthly mean temperatures vary from 14°F. to 74°F. About 70 per cent of the annual 36 inches of precipitation falls during the growing season from April through September. Thunderstorms are common and result in sudden freshets. Prolonged droughts have been experienced.

The basin lies in one of the Nation's most productive agricultural regions, and, because much of the terrain is hilly, dairying and stockraising are the predominant agricultural activities. There is considerable industrial concentration in the large cities of the basin. Small industrial plants, processing agricultural products, are dispersed throughout the basin. The value added to goods by manufacture in the six largest cities is approximately $228,000,000 per year. The estimated average per capita effective buying income in 1951 was $1,546 in the basin, $123 above the national average of $1,423.

At present 570,000 people live in the basin. Five cities have populations greater than 30,000 and one has a population of 14,000. These six cities have approximately one half of the basin's total population.

WATER USE AND WATER QUALITY OBJECTIVES

Waters of the basin serve a variety of uses, such as municipal, industrial and stockwater supplies, propagation of fish and wildlife, recreation, hydroelectric power production and navigation. Over half of the basin's population is served by community water supplies. About half of these people obtain water from four communities which use surface water from the Mississippi River. The extent of development of private industrial water supplies is unknown, but judging from the type of industries, it must be substantial.

Surface waters of the smaller streams of the basin are used extensively for watering livestock. Livestock raising, one of the basin's principal industries, depends, in a great measure, on generous quantities of good quality water. The basin's waters also serve as a recreation facility for many people. Most of the streams are heavily fished, and the waters, particularly in the headwaters regions and in the Mississippi River bottoms, serve as wildlife habitats. There are numerous recreational developments and State parks in the area. The Mississippi River supports an important commercial fishery. There are several hydroelectric power developments and some mechanical water power developments in the basin. Navigation is limited to the 155 miles of the Mississippi River included in the basin. Quite importantly, the watercourses serve as final outlets for the wastes of the basin's communities and industries.

Water quality objectives have been reasonably well established for most of the important water uses and are discussed in the body of this report. These objectives, together with desirable general sanitation objectives, such as the removal of floating and settleable solids, the elimination of nuisance conditions and the preservation of aesthetic values, provide a basis for the determination of the necessary degree of treatment for the protection of existing and foreseeable legitimate water uses.

SOURCES AND EFFECT OF POLLUTION

Over 313,000 people, more than half of the basin's population, live in 63 communities which have sewer services. Sewage with a population equivalent of 790,000 is discharged from 43 of these communities. The other 20 communities, with a sewered population of 118,000, are discharging an undetermined amount of sewage to the watercourses. Twenty-six industries are discharging organic wastes to the streams. Ten of these industries are known to have wastes with a combined population equivalent of 423,700 people. The strength of the wastes from the other 16 industries is not presently known.

Nineteen communities do not provide treatment for their wastes. These 19 communities have a sewered population of 137,800, which is approximately 45 per cent of the entire sewered population of the basin. Dubuque, Iowa, which has no sewage treatment plant and a sewered population of 45,000, is estimated to have a pollution load discharged to the Mississippi River of 250,000 population equivalent. Wastes from meat packing operations contribute the bulk of this pollution load. Clinton, Iowa, which has a sewered population of 25,000, is estimated to have a pollution load of 450,000 population equivalent contributed principally by corn products wastes. Other large cities which do not provide treatment for their wastes are Moline and East Moline, Illinois.

Twenty-one of the 48 existing municipal sewage treatment plants are considered to have inadequate capacity to handle the present load, and eight are not operated satisfactorily. One of the 13 industrial waste treatment plants has inadequate capacity and one plant is not producing a satisfactory effluent because of unsatisfactory operation.

Many of the basin's water uses are damaged to some degree by pollution. Most damage is to water for livestock although damage to fish and aquatic life has been reported in some instances. Pollution is making it increasingly difficult to provide safe and palatable water in the basin's communities using surface water supplies. Pollution is damaging water quality for fish and wildlife propagation and has impaired recreational use of some streams. Nuisance conditions are reported to exist at six places in this basin. At 28 other locations, the water is reported to be unsatisfactory for all indicated uses. For the most part, these pollution damages are localized, but, in a few instances where numerous sources of wastes exist, the pollution damage is spread over longer reaches of the streams.

PROGRESS IN POLLUTION ABATEMENT

The water pollution control agencies of the States are actively working on the pollution problem and are using existing authority in a judicious and effective manner. They work cooperatively with municipalities and industries in solving pollution problems and enforcing existing statutes. Their pollution control programs have resulted in sewage treatment being provided by 44 of the basin's municipalities. The population served by the existing sewage treatment plants amounts to 56 per cent of the basin's total sewered population. Of the 36 industries with separate outlets to streams, 13 have constructed facilities for treating their wastes.

The water pollution control laws of the States in this basin are adequate to abate existing pollution and prevent or control new or increased sources of pollution. The State water pollution control programs have been quite successful, but in order for the State agencies to pursue an effective and active program, they must be furnished with adequate appropriations to attract sufficient personnel to carry on and expand their activities.

At the present time, 11 municipalities are either actively planning new sewage treatment facilities or have plans approved for such facilities. Two industries are preparing plans and one industry has treatment facilities under construction.

POLLUTION PREVENTION MEASURES REQUIRED

Excellent work has been done on the control of pollution within recent years, but to adequately control or prevent pollution, there are still a number of projects that must be constructed. Analysis of the available data which show stream characteristics, the amount of wastes discharged to the watercourses, present water quality in the streams, and existing water uses in relation to generally accepted water quality objectives has enabled the determination of treatment requirements for the major sources of pollution in the basin. These requirements consist of 34 new sewage treatment plants (20 plants for systems without treatment which serve 138,728 people, and 14 plants for systems serving 8,355 people where the existing plant is no longer satisfactory). Enlargements or additions are needed at seven existing plants now serving 81,219 people. It is estimated that the construction of these facilities will cost approximately $9,000,000. This cost estimate does not include

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such items as sewers, interceptors, land, right-of-way, etc., which will vary with each project and with local conditions. Neither do these figures include operation and maintenance costs.

There are 15 new industrial waste treatment facilities and one enlargement required in order to adequately reduce the industrial pollution load now being discharged to the streams of the basin. Many of these needed plants will be small, since the industries for which they are needed are small plants processing agricultural products. No satisfactory estimate of the cost of the industrial waste treatment plants is possible since the nature of the wastes and possible process improvements will vary widely, even within identical industrial groups.

Additional data will be required to completely determine the total pollutional load from all municipalities and industries. However, the data now available will allow the continuation of the comprehensive program for the elimination of many of the pollutional problems that now exist.

WATER POLLUTION CONTROL PROGRAM

The needed improvement measures discussed herein and listed below are based upon studies and observations by the responsible water pollution control agencies in the States concerned, which in some cases did not include a field investigation of pollutional conditions in the receiving stream. In these cases recommendations are made on the premises of providing treatment facilities where such facilities do not now exist and for expansions and improvements to existing facilities where they are now not entirely adequate to protect the stream under all conditions. Thus, the mere fact that they are included in the listing does not always indicate the existence of a pollutional condition in the stream which is seriously damaging to water use. Nevertheless, they are deemed advisable for restoring, preserving, or protecting the stream for all legitimate water uses including those that may now exist and those that may materialize in the foreseeable future.

The corrective measures listed below are flexible and are intended to reflect the needs for the present situation as it now exists; however, changes in stream characteristics, pollutional load or water uses all may require future revisions in the treatment needed.

1. Provide the following improvements:

Name and Location	Improvement Needed	Remarks
IOWA		
Alpha		
Alpha Rendering Plant	New treatment plant	Active planning
Alta Vista Creamery	New treatment plant	
Bellevue	New treatment plant	

Name and Location	Improvement Needed	Remarks
IOWA (cont'd.)		
Calmar	Replacement of existing treatment plants	
Camanche	New treatment plant	
Castalia		
Carnation Milk Station	Enlargement of existing treatment plant	
Central City	Replacement of existing treatment plant	
Clinton	New treatment plant	
Clinton Industries	New treatment plant	
Pillsbury Mills	New treatment plant	
Swift and Company	New treatment plant	
Davenport	Enlargement of existing treatment plant	
Dubuque	New treatment plant	Active planning
Dubuque Packing Co.	New treatment plant	
Dunkerton	New treatment plant	
Elgin		
Elgin Creamery	New treatment plant	
Elkader	New treatment plant	
Farley	Replacement of existing treatment plant	
Fayette	Replacement of existing treatment plant	
Fredericksburg	Replacement of existing treatment plant	Active planning
Fredericksburg Creamery	New treatment plant	
Grand Mound	Replacement of existing treatment plant	
Guttenburg	New treatment plant	
Hawkeye	Replacement of existing treatment plant	

Name and Location	Improvement Needed	Remarks
IOWA (Cont'd.)		
Hazelton Hazelton Cheese Factory	New treatment plant	Active planning
Independence State Hospital	Enlargement of existing treatment plant	
Langworthy Langworthy Creamery	New treatment plant	
Maquoketa	New treatment plant	Active planning
Monona	Replacement of existing treatment plant	
New Hampton	Enlargement of existing treatment plant	
Oelwein Railroad Yards	New treatment plant	Under construction
Olin	New treatment plant	
Ossian	Replace 3 small plants with lift station pumping to new plant	
Oxford Junction	New treatment plant	
Preston	Replacement of existing treatment plant	
Riceville	Replacement of existing treatment plant	
Riceville Creamery	New treatment plant	
Strawberry Point North Plant	Replacement of existing treatment plant	Active planning
South Plant	Replacement of existing treatment plant	Active planning
Tripoli	Replacement of existing treatment plant	

Name and Location	Improvement Needed	Remarks
ILLINOIS		
East Dubuque	New treatment plant	Plans approved
East Moline	New treatment plant	Active planning
State Hospital	New treatment plant	Active planning
Fulton	New treatment plant	
Galena	New treatment plant	Active planning
Hanover	New treatment plant	
Moline	New treatment plant	Plans approved
Mount Carrol	New treatment plant	
Port Byron	New treatment plant	
Warren	Enlargement of existing treatment plant	
WISCONSIN		
Louisberg Creamery	New treatment plant	
Patch Grove Dairy	New treatment plant	
Platteville	Enlargement of existing treatment plant	Active planning
Potosi Brewery	New treatment plant	
Shullsburg	New treatment plant	

2. Operation of all existing and future municipal and industrial waste treatment works be brought to a uniformly efficient and high level in order to obtain maximum benefits from these facilities and permit their most effective utilization.

3. Continue the general policy of requiring adequate treatment of wastes from both new sources and expanded use of existing facilities in order to preclude new pollution problems.

Part Two

PHYSICAL DESCRIPTION

The basin area includes parts of four States, namely, Minnesota, Iowa, Wisconsin and Illinois. The total area involved is 9,530 square miles with Iowa having about 75 per cent of the total basin area. Wisconsin has about 15 per cent of the area while 10 per cent lies in Illinois. Only 13 square miles, or less than one-fifth of one per cent of the basin, are situated in Minnesota.

The basin, from the Mississippi River near Davenport, Iowa, to the headwaters of the Wapsipinicon River in Minnesota is about 185 miles long and approximately 70 miles wide at the point of greatest width.

The Wapsipinicon River, the largest of the rivers considered in this report, drains an area of 2,563 square miles. It rises in the southeast corner of Mower County, Minnesota, at an elevation of about 1,250 feet above mean sea level and falls approximately 685 feet as it flows 255 miles to join the Mississippi River above Princeton, Iowa (338 miles below St. Paul). The Wapsipinicon River valley is only 10 miles wide and contains no major tributaries.

The Maquoketa River, with a watershed of 1,903 square miles, lies to the northeast of the Wapsipinicon watershed. It rises in Fayette County, Iowa, approximately 1,160 feet above mean sea level and discharges into the Mississippi River about 43 miles above the Wapsipinicon, after flowing a distance of 132 miles and dropping 577 feet. The principal tributary is the North Fork of the Maquoketa River, a stream draining 587 square miles.

The Turkey River, the other major stream in the basin, lies to the north of the Maquoketa River basin and drains an area of 1,696 square miles. It rises at an elevation of about 1,300 feet above mean sea level and flows a distance of 135 miles to join the Mississippi River 235 miles below St. Paul. The important Turkey River tributaries are the Volga and Little Turkey Rivers.

Five rivers drain the portion of the basin east of the Mississippi River. These are the Grant and Platte Rivers in Wisconsin, the Apple and Plum Rivers in Illinois, and the Galena River which drains portions of both States. The area is about equally divided among these five rivers as each has a watershed area of approximately 500 square miles.

The upper part of the basin is characterized by fertile soils of a sandy or gravelly nature and by rolling to hilly topography. Near the Mississippi the terrain becomes rugged and the streams have fairly steep slopes. As a result, flash floods occur which cause serious local damage to property and farmlands. The soils in the lower part of the basin are a rich prairie loam.

The glacial formation of the basin represents the materials deposited by the Iowan, Kansan and Illinoian ice sheets. The major portion of the Wapsipinicon basin lies within the area of the Iowan drift. The balance of the area is in the terrain of the Iowan, Kansan and Illinoian drifts with the exception of the lower portions of the Volga and Turkey Rivers which are in the area commonly termed "driftless" or unglaciated. However, the so-called

"driftless" area has remnants of the Nebraskan drift on the upland areas and, in a few instances, in sink holes or depressions. Thus the topography for the major portion of the Wapsipinicon basin is a constructional type of youthful stage, while that developed by the other streams is a destructional type in a mature stage.

The climate of the basin is temperate. The mean annual temperature is about 50°F., with average January temperature ranges from 14°F. to 18°F., while average July temperatures vary from 72°F. to 74°F.

The average annual precipitation varies from about 32 inches in the north to 36 inches in the area along the Mississippi River. About 70 per cent of the annual precipitation falls during the growing season from April through September.

The streams of the basin are characterized by great variations in flow. The Turkey River at Garber, Iowa, has a maximum flow of 29,000 c.f.s., a minimum flow of 46 c.f.s., and an average flow of 863 c.f.s. for the 29 years of record. The Maquoketa River near Maquoketa, Iowa, has a maximum flow of 48,000 c.f.s., a minimum of 39 c.f.s., and 37-year average flow of 969 c.f.s. Sixteen years of records are available for the Wapsipinicon River near DeWitt, Iowa. This stream has an average flow of 1,573 c.f.s. for the period of record, but the flow variations range from a minimum daily flow of 70 c.f.s. to a maximum daily flow of 26,000 c.f.s. Other streams of the basin have similar large fluctuations in flow. Unlike some of the rivers in adjacent basins, the major streams of this basin have never been reported as having more flow at those points where gaging stations have been established. However, average daily flows of less than 10 c.f.s. have occurred at several of the stations. Minimum average monthly flows also vary over a large range. For instance, the minimum average monthly flows of the Wapsipinicon River near DeWitt, Iowa, vary from 80.1 c.f.s., for January, 1940, to 811 c.f.s., for May, 1942.

Because of the rugged topography, extremely high runoff occurs in the spring and frequently amounts to more than the railfall because of melting snow. For this reason, spring floods are numerous in this region. Runoff in the Wapsipinicon basin has varied from 2.79 inches per year in 1940 to 15.09 inches per year in 1947. Runoff in other watershed areas of the basin varies in a similar manner, although the ratio of minimum to maximum differs from basin to basin with a minimum spread of 6.16 to 14.46 occurring in the Platte River basin.

Low flows on the streams of the basin generally occur during late summer and early fall months and again during midwinter. Low flows on some of the minor tributaries have approached or reached no-flow conditions during the periods of extended drought.

The effects of pollution are increased during periods of low flow, either when temperatures are high or when the streams are covered with ice. During warm weather, the amount of oxygen that the stream can absorb is considerably reduced, and bacterial growth is accelerated. In periods of low

temperature and heavy ice coverage, there is little opportunity for reaeration of the water, and consequently it is difficult for the stream to naturally overcome the effects of pollution. As a result, critical flows become an important factor in determining the waste treatment necessary to provide water of suitable quality for the legitimate water uses.

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ECONOMIC DEVELOPMENT

This basin does not have the intensive farming that is found in the areas to the south and east because of the extremely rugged topography found over a large portion of the basin. However, agriculture, the most important source of income in this basin, is adapted to the terrain with dairy farming predominating in the northern portion of the basin, while in the southern portion the raising of livestock is practiced. Approximately 75 per cent of the farm income was derived from livestock and livestock products in 1940, while 13 per cent of the income came from crops and other land products.

Although agriculture is perhaps the most important industry in this basin, other industry, particularly manufacturing, has increased in extent and importance within the last two or three decades until it is now of such a size that the industrial income has become very important to the economy. Most of the larger manufacturing plants are located in the six largest cities - Davenport, Dubuque and Clinton, Iowa, and Rock Island, Moline and East Moline, Illinois. These manufacturing centers produce metal products, machinery, clothing, chemicals, primary metals, fabricated metal products, transportation equipment, meat and dairy products, cereals and flour. According to information obtained from "Census of Manufacturers, 1947," Bureau of Census, it is estimated that the total value added to goods by manufacture in these six cities was approximately $228,000,000. The estimated average effective buying income in 1951 was $1,546 per capita in the basin. This was $123 above the national average of $1,423 per capita.

While most of the manufacturing activity is concentrated in the large cities, there are a large number of small manufacturing plants widely dispersed throughout the basin. Most of these small plants process dairy and meat products received from the immediately surrounding farm area. The Mississippi River is used for commercial navigation, but the value and tonnage of the freight handled at the port cities is not known.

The 1950 basin population totaled about 570,000 with 70 per cent residing in Iowa, 25 per cent in Illinois and 5 per cent in Wisconsin. Approximately one half of the basin's population (254,600) live in the six large manufacturing cities. There are 23 communities with populations between 1,000 and 2,500; 14 communities with populations between 2,501 and 10,000; one city with a population of 13,900; four with populations between 30,000 and 50,000; and one with a population of 74,500. There are approximately 60 persons per square mile in this basin.

The development of head for water power is not difficult in this basin because of the deep narrow valleys and the rapid fall of the streams. The disadvantage from a power standpoint is the small flow available; as a result, only a few hydroelectric plants are in operation in this basin.

The many scenic valleys of the basin afford opportunity for hunting, fishing and other recreation. However, this area is devoid of natural lakes and the streams are the only natural source of recreation water and water for wildlife. The headwaters of the streams support an abundant fish life in many

reaches. The demand for lakes in this area has resulted in the construction of artificial lakes and impoundments at a few locations. There are several State parks and game refuges in the basin. The farming operations throughout the region provide excellent food and cover for many species of upland game birds while the Mississippi River sloughs are valuable fish and game areas.

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USES OF WATER RESOURCES

Important uses of the basin's waters include: domestic, industrial and livestock supply; fishing; wildlife; bathing and other recreation; and navigation. The primary use in some areas is domestic and industrial supply, but the predominant uses throughout the basin are livestock supply, fishing and wildlife. Navigation and commercial fishing are limited to the Mississippi River.

The four communities in this basin which use surface water obtain their public water supplies from the Mississippi River. These four communities, with a 1950 population of approximately 166,000, supply 146,000 people with a total of over 15 million gallons of water per day. One hundred and fourteen communities use underground water and serve 181,000 people with over 14 million gallons of water per day.

Source water quality objectives are among the factors considered in determining waste treatment requirements for pollution sources upstream from municipalities. In determining suitability of source water for domestic supply, State health and water works officials use Public Health Bulletin 296, "Manual of Recommended Water Sanitation Practice," as a guide.

The raising of dairy and other livestock is not only the primary agricultural activity, but is an activity of great economic importance to this basin. The use of surface streams for livestock water supply is widely practiced and of paramount importance. Water quality objectives for stock-watering have not been precisely defined, but the authorities agree that the elimination of such pollution as floating and settleable solids and high bacteria concentrations is desirable if the water is to be used for agricultural purposes.

The amount of surface water used by industry for cooling or process purposes, with or without treatment, is not known, but it seems reasonable to assume that, with the importance that industry has reached in this basin, the quantity of surface water required and used must be large. Because of the diversity of processes, quality requirements for industrial water supplies vary widely, depending upon the needs of the industry under consideration. No specific criteria have been adopted, but each industrial use must be considered separately. Of general concern are the organic and biological constituents, toxic substances, and properties of corrosion, encrustation and slime formation of the available waters.

The streams of the basin are extensively used for recreational purposes including fishing, boating, cabin sites, camping, and picnicking. Since few lakes are available, heavy angling pressure is applied to the streams. Part of the popularity of recreational use of the streams is due to the fact that most of the cities, and therefore the greatest population, are adjacent to streams which are used during weekends and holidays during a large part of the year. Sport fishing in the portion of the Mississippi River covered by this report is popular while commercial fishing on the river and adjacent sloughs is a substantial industry.

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Dyersville
Epworth
Farley
Worthington
Cascade
Sand Spring
Hopkinton
Ryan
Coggon
Monticello
Langworthy
Central City
Anamosa
Amber
Center Junction
Oxford Junc
Olin
Lost Nation
Clarence
Lowden
Wheatland
Grand Mound
Delmar
Charlotte
Andrew
Bellevue
Preston
Maquoketa
Sabula
Savanna
Mt Carroll
Argo
Fulton
Hanover
Elizabeth
Shockton
Warren
Culture
Cuba
Shullsburg
Readlyn
Dumont
Dunkerton
Delwein
Fairbank
Aurora
Lamont
Ingleton
Independence
Manchester
Winthrop
Quasqueton
Karlville
Delhi
Princeton
Le Claire
Port Byron
Comanche
Deewitt
Loran
Mississippi
Wapsipinicon
Turkey
Volga
Maquoketa
Buffalo
Crane
Otter
Plum
Little
Deep
Yellow
Apple
Catfish
Big Rock
Rock
Green
Pecatonica
Galena
Sinsinawa
Platte
Grant
Little Maquoketa
Big Maquoketa
Wapsipinicon
Crane Creek
Otter Creek
Buffalo Fork
Little Maquoketa River
Big Maquoketa River
Wapsipinicon River
Turkey River
Volga River
Yellow River
Apple Creek
Catfish Creek
Big Rock Creek
Rock River
Green River
Pecatonica River
Galena River
Sinsinawa River
Platte River
Grant River

Contamination of bathing waters by sewage, especially that of recent origin, is objectionable, as water for recreational usage should be free from floating solids, sludge banks, odors and discoloration. Quality objectives for the bacteriological quality of bathing waters recommended by the Joint Committee on Bathing Places (Joint study by the American Public Health Association and Conference of State Sanitary Engineers, covered in a report entitled "Recommended Practice for Design, Equipment, and Operation of Swimming Pools and Other Public Bathing Places," 1949), together with sanitary surveys, are employed in the administration of pollution control programs as related to bathing waters of this basin. Under the Joint Committee interpretation, various classifications of waters are defined as based on the number of coliform organisms per 100 milliliters of water. Other indices of quality, as enterococci, are receiving increasing attention; however, sanitary surveys are employed in pollution control programs as related to bathing waters. Although quality objectives for water used for non-swimming recreation do not set forth as high a bacteriological criterion, the same basic fundamentals are used by the States in their programs.

The U. S. Fish and Wildlife Service has set forth certain criteria for fresh-water fish which are used by the States in their water pollution control programs. These criteria call for a balanced aquatic biota and the elimination of sludge beds, silt sedimentation, and other deposits which tend to blanket the stream bottom and destroy the biological life.

The development of water power is not difficult in the basin, but the small flows available restrict the size of installations which can be secured except on the Mississippi River.

All of these water uses are considered essential for the improvement of the economic conditions, health and welfare of the people in the basin, and conservation of the water resources must be practiced for the continued development of the area. Treatment of the wastes discharged to the watercourses will be necessary to achieve the pertinent water quality objectives and thus maintain the streams in a suitable condition for the indicated water uses.

POLLUTION CONTRIBUTED TO WATER RESOURCES

There are 63 population centers in the basin served by sewerage systems having a connected population of about 313,000. For 43 of these on which data are available, the amount of pollution discharged to watercourses was equivalent to almost 790,000 people although the population actually served by these sewerage systems was about 195,000. This reflects the large amount of industrial wastes being discharged to municipal sewerage systems.

TABLE A
SEWERED MUNICIPALITIES*

Municipalities*	Number	Population Served by Sewerage System	Amount of Pollution Discharged to Watercourse (In Terms of Equivalent Number of People)
Having data on pollution load discharged to watercourse	43	194,975	789,880
Having population data available (Data on pollution load to watercourse incomplete or not available)	20	118,238	Not applicable
TOTAL	63	313,213	xxx xxx

* Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers; sanitary sewage wastes discharged by industries directly to watercourse; and industrial wastes discharged into municipal sewerage systems.

Ten industrial establishments discharge organic wastes through separate outfall sewers contributing a known pollutional load equal to wastes from a population of about 423,700. Besides these ten, there are 16 other organic waste producing industrial plants for which pollution data are not available. Three plants produce both organic and inorganic wastes.

TABLE B
SEPARATE INDUSTRIAL* OUTLETS

Industries*	Number	Amount of Pollution Discharged to Watercourse (In Terms of Equivalent Number of People)
Producing Organic Wastes	10[1]	423,700
Producing Organic Wastes	16[2]	Not known
Producing Inorganic Wastes	13	Not applicable
TOTAL	36	xxx xxx

* Industries having separate outlets discharging wastes directly to watercourse.

[1] Includes one plant which also produces inorganic wastes.

[2] Includes two plants which also produce inorganic wastes.

On the basis of population equivalent, the above data indicate the total known sewage and industrial organic wastes discharged to the watercourses to be equivalent to the wastes from over 1,213,000 people. This is nearly four times the entire sewered population within the basin, and does not include those municipalities and industries where the amount of pollution discharged to the watercourses is not known.

Of the 63 communities with sewerage systems, 44 provide treatment for their wastes, but the 19 communities which do not provide treatment have a sewered population of 137,828 which is approximately 45 per cent of the entire sewered population. Dubuque, Iowa, which has no sewage treatment plant and a sewered population of 45,000, is estimated to have a pollution load discharged to the Mississippi River of 250,000 population equivalent. Wastes from meat packing operations contribute the bulk of this pollution load. Clinton, Iowa, which has a sewered population of 25,000, is estimated to have a pollution load of 450,000 population equivalent contributed principally by corn products wastes.

Other large cities which do not provide treatment for their wastes are Moline and East Moline, Illinois. Of the remaining 15 communities without treatment facilities, eight have sewered populations between 1,000 and 5,000, while seven have sewered populations under 1,000.

In addition to the pollution load added by untreated wastes discharged to the watercourses, the major portion of the remaining pollutional load is created by the discharge of effluents from 21 municipal sewage treatment

N
WISCONSIN
ILLINOIS
I O W A
DUBUQUE
E Dubuque
CLINTON
DAVENPORT
MOLINE
ROCK ISLAND
Bellevue
Andrew
Preston
Sabula
Princeton
Fulton
Camanche
Port Byron
Lecloire
Sherrill
Peosta
Epworth
Farley
Worthington
Cascade
Ryan
Hopkinton
Cedar
Monticello
Center Junction
Oxford Junction
Lost Nation
Clarence
Wheatland
Grand Mound
Low Moor
Charlotte
Delmar
Miles Junction
Otter Creek
Central City
Coggon
Winthrop
Manchester
Earlville
Delhi
Dyersville
Petersburg
Holy Cross
New Vienna
Luxemburg
Colesburg
Edgewood
Strawberry Point
Elkport
Volga City
Elkader
Guttenberg
Garnavillo
St Olaf
Elgin
Clermont
Monona
Luana
Castalia
Osterdock
Garber
Postville
Waterloo
Arlington
Maynard
Fayette
Wadena
Sumner
Tripoli
Frederiksburg
Hawkeye
Alpha
New Hampton
Lawler
Protivin
Ossian
Cresco
Riceville
Mt Hamilton
Fenimore
Patch Grove
Bagley
Bloomington
Lancaster
Platteville
Shitzer
Arthur
Cuba City
Shullsburg
Lowden
Galena
Savanna
Thomson
Morrison
Stockton
Elizabeth
Lanark
Mt Carroll
Lenark
Argo
Milledgeville
Oregon
Dunleith
Hanover
Scales Mound
Warren
Guilford
Apple River
Durand
Freeport
Pecatonica
Winslow
Rockton
Roscoe
Beloit
Turtle Creek
Rock River
Yellow River
Plum River
Little Maquoketa River
Maquoketa River
Wapsipinicon River
Crow Creek
Flora Creek
Mississippi River
Galena River
Apple River
Pecatonica River
Sugar River

plants with inadequate capacity. These plants serve a total sewered population of 90,275. Unsatisfactory operation of existing facilities is not a major cause of pollution in this basin as the total combined population served by the eight plants with inadequate operation is only 6,078.

The majority of the industries which discharge wastes directly to the watercourses are food and kindred products industries. The second largest group is fabricated metal plants with chemical and allied products being next in line.

The Department of Agriculture points out that the quantities of silt borne by the streams are evidence that soil conservation practices are, at present, not carried out in sufficient magnitude to prevent erosion of substantial amounts of soil. This silt is a form of pollution which can impair the water for many uses, such as water supply, for domestic and industrial purposes, stock watering, fish and wildlife propagation, and swimming. This inorganic pollution is more in evidence during high water as contrasted to the effects of organic pollution which are usually more noticeable during low flow conditions.

DAMAGES TO WATER RESOURCES FROM POLLUTION

In certain areas pollution has caused damage to legitimate water uses. The amount of damage varies with the degree of pollution and depends upon the extent to which the major existing water uses are affected and potential water uses are held in abeyance by unsatisfactory water quality. In most areas of the basin, streams are undamaged by pollution, either because of the absence of sources of heavy pollution or because the amount of wastes discharged does not exceed the pollution assimilation capacity of the streams consistent with other water uses. Water use damages result from bacterial pollution, deoxygenation by organic pollution, toxicity, increased hardness, chloride content, or presence of color, odor, or taste producing substances. Where nuisance conditions prevail, all existing water uses along the stream for some distance below the source of pollution are damaged and other additional uses are prohibited by the excessive pollution load with which the stream is burdened.

There are six places in this basin where nuisance conditions are reported to exist. At 28 other locations, the water is reported to be unsatisfactory for all downstream uses. These damages are localized in character and do not extend very far below the source of pollution.

A significant percentage of the municipal population obtains its public water supplies from surface sources (the Mississippi River). When the raw water is highly polluted, an increased burden is placed on the water plant operators to insure that a safe, potable water is produced at all times. Where the bacterial load in the raw water is high, a very close watch must be maintained at all times to insure that there is no breakdown of treatment facilities and sterilization equipment. The failure of certain vital equipment in the water treatment plant could allow the discharge of inadequately treated water to the city mains.

Where surface waters are badly polluted because of sewage or industrial waste discharges, additional expenditures of funds will be required to adequately treat this water for either domestic or industrial use since chemical costs for treatment will increase and, in some cases, additional equipment will be required.

Water used by industry must meet quality standards dependent upon the processes involved. Boiler water must be soft and noncorrosive; the canning of foods requires a high quality water with a minimum of dissolved solids; bottling works need a water free of taste and odors and there must be an absence of chemicals or organisms which might develop precipitates or aftergrowths.

Livestock and domestic fowl watering, the predominant use made of the basin's waters, is reported to be damaged frequently by pollution. The damage involves complete loss of use of the water in the more grossly polluted reaches, or potential hazard to the stock in the form of toxic materials or disease organisms.

Sport fishing also has suffered from pollution. In cases of heavy pollution, and even in cases of mild pollution where stream flows are reduced

considerably at time of drought, fish propagation is made difficult if not impossible. This damage causes loss to the sportsman in the form of increased costs for traveling to waters where fishing is possible. In those cases where time or finances do not permit longer travel distances, the complete loss of the recreational opportunity afforded by fishing or water recreation is of considerable importance.

Other recreational use of the waters is not practical as frequently as it might be were all pollution abated. Such activities have been restricted or completely eliminated in some instances by excessive pollution.

Commercial fishing on the Mississippi River is reported to be seriously damaged by pollution. Commercial fishermen complain that their hoop nets sometimes become clogged with a filamentous organism or fungus and that seines sometimes become so loaded with this growth that they could not be hauled to the shore and landed. Some areas of the river which formerly supported excellent commercial fishing have been rendered useless.

Not to be overlooked is the damage to property values. Condition of the water is an important consideration in locating on or near a stream or lake, or in developing waterfront property. There is little doubt that property values have suffered some loss due to pollution in those cases where nuisance conditions exist in this basin, but no data are available to indicate the extent of damage.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

The existing municipal sewage treatment plants of the basin have been of great value in preserving the water resources. Had it not been for these plants, pollution would have increased with the settlement and development of the basin until water use would have been more seriously damaged than it is now. Man cannot live in his environment and maintain it in its virgin state. However, man who continues to pollute his environment with his wastes eventually realizes a loss that he could have prevented, but which he can correct only through the expenditure of considerable money and effort.

The water resources of this basin have not been damaged beyond recovery, but they have reached a point where correction of polluted conditions is desirable. By abating existing excessive pollution, the damaged water uses can be restored, and by preventing additional pollution, the future water uses will be preserved. The basin's water resources are vital to its continued prosperity, and expenditures made to preserve them will be returned to the people in many ways.

There are only four domestic water supplies using surface water sources, but these serve almost 25 per cent of the basin's entire population. It is important that the quality of these source waters be preserved by protecting them from further pollution.

Availability of good quality water is a requisite to development of many industries and a major factor in locating industrial plants. This is particularly true of the food processing industries which are so prevalent in this basin. When other factors dictate plant location, the availability of water of the required quality is reflected in the cost of the industry's product. This is of economic importance to the region in maintaining existence of the plant as well as to the farmer who produced the raw materials for the industrial plant.

Pollution abatement and preventive measures will restore waters lost to the farmers in certain areas and assure adequate quality water for livestock use. This benefit is of economic importance to the basin and also to the Nation as a whole.

Pollution control measures are necessary to assure increased and continued benefits of recreational use of the basin's waters. Abatement of pollution will aid in promoting wider development of these resources and prevention of future pollution will assure continued use. Wider development of the water resources for recreational use will mean shorter traveling distances from population centers to fishing, bathing, and boating sites and will result in reduced costs and increased recreation time. This benefit is important to all of the basin's people and it is especially important to those who reside in the urban areas.

POLLUTION PREVENTION MEASURES IN EFFECT

Forty-four of the 63 communities in this basin with sewer systems provide treatment for their wastes. These communities provide treatment for about 56 per cent of the total sewered population.

TABLE C
EXISTING TREATMENT FACILITIES
MUNICIPAL

Degree of Treatment Provided	Number Municipalities*	Plants	Population Served
Primary	13	12	123,871
Secondary	31	36	51,514
No Treatment	19	--	137,828

* Includes incorporated and unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers, industrial wastes discharged to municipal sewerage systems.

Twenty-one of the existing municipal treatment plants, however, are reported to have inadequate capacity and do not provide sufficient treatment to protect the receiving stream from pollutional damage. Twenty-five plants are considered to have satisfactory capacity and 38 of the existing plants are believed to be operating satisfactorily. A number of the communities with plants now classified as having inadequate capacity are planning for improvements required to provide sufficient capacity to satisfactorily handle the loads expected.

Table D lists the industrial sources of pollution according to the type of industry and shows the number of each type which provide treatment for their wastes. It will be seen that the food processing industry has the largest number of plants with separate outlets discharging wastes directly to receiving waters. The table shows that there is a total of 36 industrial plants discharging wastes and that 13 of these have provided treatment facilities, 21 have not provided treatment, and the facilities of two are undetermined. Eleven of the existing industrial waste treatment plants have satisfactory capacity, one does not have adequate capacity and the adequacy of one plant has not been determined.

TABLE D

EX NG TREATMENT FACILITIES

INDUSTRIAL*

Type of Industry	Number of Plants	Number of Industrial Plants Having: Treatment Facilities	No Treatment Facilities	Undetermined Facilities
Food and Kindred Products	21	4	15	2
Chemical and Allied Products	3	1	2	0
Textile	1	0	1	0
Fabricated Metals	5	4	1	0
Paper and Allied Products	1	0	1	0
Primary Metals	2	2	0	0
Mining	2	2	0	0
Miscellaneous	1	0	1	0
Total	36	13	21	2

* Industries having separate outlets and discharging wastes directly to watercourses.

The 25 sewage treatment plants with satisfactory capacity serve over 85,000 people or about 27 per cent of the sewered population. In all but three cases these plants are located in communities of less than 5,000 population and only one has an appreciable quantity of industrial waste in its sewage.

TABLE E

ADEQUACY OF EXISTING TREATMENT FACILITIES

Existing Treatment Facilities	Total Number	Adequacy with Relation to: Capacity Satisfactory	Capacity Unsatisfactory	Capacity Undetermined	Operation Satisfactory	Operation Unsatisfactory	Operation Undetermined
Municipal	48	25	21	2	38	8	2
Industrial	13	11	1	1	11	1	1

The 21 municipal sewage treatment plants which are considered to be overloaded are serving a combined population of 90,275 or about 28 per cent of the sewered population. The unsatisfactory capacity of many of the existing municipal waste treatment plants is probably due to the fact that many have been in service for a long period of time. The basin's first sewage treatment plant was placed in operation in 1911. Over one-third of the plants are 30 years old and half of them are 20 years old. Fifteen new sewage treatment

plants have been constructed since 1940. The work that has been done and is being done to control pollution is encouraging, but there are points on the streams in this basin where additional control work is needed.

TABLE F
PROGRESS IN POLLUTION ABATEMENT

	Municipal		Industrial	
Year	Plants Completed	Design Population	Plants Completed	Amount of Waste Treated (in terms of equivalent no. of people)
1947	0	0	0	0
1948	0	0	2	11,000
1949	1	1,000	2	3,000
1950	5	22,400	1	10,000
1951	1	1,000	0	0
1952	0	0	0	0

The number of existing plants and the number of communities which have treatment plant plans approved and ready for construction illustrates the excellent job that the State water pollution control agencies have been doing; however, the activities of the agencies concerned have been hampered by lack of sufficient trained personnel and sufficient appropriations to properly expand their activities to meet the increased problems that confront them. It will be necessary to provide adequate appropriations if efficient, well-operating pollution control organizations are to be maintained at a level that will permit further progress in pollution abatement.

The water pollution control laws of these four States are adequate to abate existing pollution and prevent or control new or increased sources of pollution. The water pollution control agencies have been given sufficient legal authority with which to carry on their programs and they have used this authority judiciously and effectively in carrying out their work. The following brief analysis presents the salient features of water pollution control legislation of three of the States in the basin. A summary of the Minnesota legislation is not included since only a very small fraction of the basin lies in that State.

In Iowa the water pollution control act vests the principal authority in the State Department of Health. The Iowa Natural Resources Council and State Geologist also have certain functions relating to water pollution. The Iowa Natural Resources Council makes surveys of health and pollution problems relating to flood control. The State Geologist is responsible for protection of waters from pollution by oil and gas wells.

There is no specific statutory authority granted to the State Department of Health to develop a comprehensive program, to set standards of water purity, or to classify waters. However, the Dep rtment is authorized to exercise general supervision over public health, to promote public hygiene and sanitation, to investigate and prevent water pollution, and to make necessary

rules. The Department is authorized to issue written permits, after approval of plans and specifications, for new sewerage or industrial waste systems as well as extensions or additions which would substantially increase water pollution.

The Department may hold public hearings on water pollution and may order abatement of pollution. However, the order cannot be issued without the written approval of the majority of the members of the Iowa Natural Resources Council. Penalties are provided for violations of orders issued or for unlawful pollution of State waters.

There are no exemptions from the operation of the act since removal in 1949 of the restrictions under which the authority of the Department did not apply to the border streams. The last amendments to the existing statutes of the State of Iowa considerably strengthen previous water pollution control legislation, under which a large measure of progress was made. Disposal of garbage and night soil into streams or on land subject to overflow is prohibited by an old statute not under direct administration or enforcement by the State Department of Health.

In Illinois control of water pollution is vested in the Sanitary Water Board under the Act of 1951, which superseded the Act of 1929. The Board has the authority to carry on comprehensive water pollution control programs, adopt rules and regulations, hold hearings, issue orders, and recover money sufficient for restoration of fish life which has been destroyed as a result of the violation of the act. The law also provides other penalties for violation of the act and enables the Board to control or prevent new or increased sources of pollution.

The 1951 Act includes provisions for requirement of certification of municipal sewage treatment plant operators as well as industrial waste treatment plant operators. The Sanitary Water Board Act does not apply to any existing sanitary district having a population of one million or more. There is some overlapping of jurisdiction between the Sanitary Water Board and the Conservation Department, which protects fish and wildlife from pollution. Pollution originating from oil field wastes comes under the jurisdiction of the Department of Mines and Minerals.

In Wisconsin the primary responsibility for the water pollution control program has been vested in the Committee on Water Pollution. The State Board of Health also has comprehensive water pollution control functions. The 1927 Wisconsin State Legislature created the Committee on Water Pollution and designated its powers and duties. This legislation was called the State Water Pollution Control Act and was last revised in 1949.

The Committee on Water Pollution has authority to make studies and investigations as well as conduct scientific experiments and research, hold hearings, issue orders, enter into agreements with other States and with the Federal Government, and can obtain enforcement of orders through court action. The Committee on Water Pollution consists of the State Chief Engineer, a member or other representative of the Public Service Commission designated by the

Commission, a conservation commissioner or an employee designated by the Conservation Commission, the State Health Officer or a member of the Board of Health designated by the Board, and the State Sanitary Engineer or other engineer appointed by the State Board of Health.

Formal orders to municipalities and industries for abatement of pollution have not been widely used as an administrative procedure in this basin. Instead, water pollution control agencies of the States have preferred to use a cooperative approach working closely with polluters in an attempt to secure abatement without exercising police powers. Generally formal orders have been used only in those cases where the cooperative approach has not been successful.

The water pollution control agencies of Illinois, Iowa, and Wisconsin have jointly resolved (in a meeting held at Davenport, Iowa, on March 7, 1952) that, insofar as the Mississippi River is concerned, each does "agree to require the correction of existing and prevention of additional pollution within the boundaries of its State to the end that said waters may be maintained or rendered suitable for all purposes heretofore defined and that in the attaining of these objectives the guiding policy shall be the requirement that facilities for treatment of sewage and for industrial wastes shall provide at least effective sedimentation or equivalent, substantially complete removal of floating solids or liquids, and reduction of toxic materials to less than lethal limits for aquatic life, with the understanding that additional or special type treatment may be required in those areas where water uses so dictate...."

The States also have a policy of not issuing permits for the construction of new sewer systems or extensions of existing ones unless the community requesting the permit has, or is actively planning to construct, adequate treatment facilities.

The Department of Agriculture points out that all of the watershed area except the 1 per cent which lies in Minnesota is now organized into soil conservation districts. The Soil Conservation Service, working through these districts, provides technical assistance to the farmers in installing conservation practices such as contour farming, contour strip cropping, terracing, and improved rotations. All of these practices tend to reduce the sediment loads of the streams.

POLLUTION PREVENTION MEASURES REQUIRED

To obtain the maximum utilization of the waters in the Mississippi, Wapsipinicon and Tributaries Rivers Basin, sewage and industrial wastes discharged to the watercourses must be treated to protect the receiving streams so that water of suitable quality is provided for the legitimate water uses. In view of the expanding industry in this area and the importance of agriculture to the economy of the region, the desired quality of the surface waters should be preserved for these uses in order to stimulate the greatest advancement of the economy of the whole basin. In addition, there is the moral obligation to protect the rights of downstream water users.

Water quality objectives which are pertinent to this basin have been discussed in that section of this report entitled "Uses of Water Resources." The type and design of each individual sewage treatment plant depends upon several variable factors that can be determined only after an engineering survey of local conditions. The exact amount and/or type of wastes discharged are not known for several of the smaller problems in the basin, but in these cases preliminary studies and estimates are sufficient to set forth the need for a local engineering survey which in turn will result in the determination of the exact type and degree of treatment needed. To insure that the treatment facilities will satisfy the requirements and to safeguard the taxpayers' investment, the State water pollution control agencies require the submission of plans for approval before construction is undertaken.

For much of this basin, the degree of treatment required is influenced by the amount of dilution water available during periods of critical low flow. In this region, two separate and distinct critical stream flow periods occur--the first during the late summer and early fall and the second during midwinter. During low flow periods in hot weather, the water temperature rises and reduces the capacity of the stream to absorb and hold oxygen, and at the same time accelerates the rate of biological activity with a corresponding increase in the amount of oxygen required. During winter conditions of low flow, heavy and prolonged ice cover precludes or diminishes reaeration of the stream water, and biological activities, while progressing at a lesser rate than during periods of warm weather, must be wholly supported by oxygen contained in the receiving waters prior to the discharge of pollution. Where the quantity of discharge is large, as is the case in the principal communities where industry is concentrated, undesirable stream conditions are accentuated. It seems reasonable to expect that a high degree of treatment will be essential at those points where stream flows are critical in order to keep residual loadings within the stream's capacity for assimilation during low flow periods.

Preventive and corrective pollution control measures have been determined from results of stream surveys and other readily available data of the State agencies concerned. Construction of presently needed facilities and the adoption of waste prevention measures as soon as possible will restore, preserve, and protect existing legitimate water uses and those which may materialize in the immediate future. Required control measures were determined only after a thorough consideration of all water uses and are considered to be

reasonable and adequate. At the same time, it should be kept in mind that the corrective measures are intended to be flexible and to reflect the needs of the existing situation; however, changes in stream characteristics, pollutional load or water uses may require that revisions be made in the indicated required treatment at some future date.

Considerable progress has been made in the basin in providing municipal and industrial waste treatment plants, but much additional plant construction, replacement, and expansion are needed before all waters of the basin will be adequately protected from the effects of municipal and industrial pollution. There is also a need for improved operation at a few plants. Failure to operate waste treatment works at, or near, the peak of efficiency for which they were designed means that clean streams are not obtained as estimated, and funds spent in anticipation of clean streams are largely wasted.

The presently available information shows that 20 new sewage treatment plants are needed to serve an estimated total of 138,728 persons. One of these new plants is needed to serve a city with a sewered population of 45,000 and a total combined municipal and industrial pollution load estimated to be equivalent to that from 250,000 people. Two new plants are needed to serve cities with sewered population of 25,000 and 35,000; one is needed to serve a connected population of 12,000; eight are needed by communities with sewered populations between 1,000 and 5,000; and the balance for communities with less than 1,000 persons connected to their sewerage systems.

There are 14 existing sewage treatment plants that, because of age or gross overloading, can no longer efficiently produce a satisfactory effluent and should be replaced. These plants now serve a total sewered population of 8,350. In addition, there are seven existing municipal waste treatment plants, now serving an estimated population of 81,220, to which enlargements or additions should be made so that these facilities can do an adequate and proper job in controlling stream pollution.

There are, in contrast to the above requirements, 22 existing municipal sewerage systems with a total connected population of 83,700 that are considered to be completely satisfactory for present conditions, and no additional treatment facilities are required for these communities.

Using available cost data and making approximations of unknown cost factors, it is estimated that the cost of constructing the needed municipal facilities would total about $9,000,000 for this basin. An accurate estimate of the cost of construction of needed community waste treatment facilities is difficult since the cost of each project will depend upon local factors. The cost estimate given above covers treatment facilities only and does not include cost of land, right-of-way, collection sewers, etc., nor does it take into account maintenance and operating costs.

LOCATION MAP

MUNICIPAL / INDUSTRIAL

NO POLLUTION ABATEMENT NEEDS

POLLUTION ABATEMENT NEEDS UNDETERMINED

POLLUTION ABATEMENT NEEDED

POLLUTION ABATEMENT NEEDS INDICATED BY LETTERS APPEARING BY "POLLUTION ABATEMENT NEEDED" SYMBOLS, AS FOLLOWS.

A NEW TREATMENT PLANT OR OTHER POLLUTION CONTROL MEASURES

B ENLARGEMENT OR ADDITIONS TO EXISTING PLANT

C REPLACE EXISTING PLANT

NOTE When more than one source of industrial pollution occurs in an area numbers appearing by symbols indicate total number of needs in the category designated.

MISSISSIPPI - WAPSIPINICON & TRIBUTARIES RIVERS BASIN

MUNICIPAL AND INDUSTRIAL POLLUTION ABATEMENT NEEDS

U. S. DEPARTMENT OF
HEALTH EDUCATION AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 3

TABLE G
REQUIREMENTS FOR MUNICIPAL AND INDUSTRIAL
WASTE TREATMENT PLANTS

Requirements	Municipal		Industrial
	Number	Population Served by Facilities	Number
New Plant	20	138,728	15
Enlargement or Additions to Existing Plant	7[1]	81,219	1
Replace Existing Plant	14[2]	8,355	0
No Project Required	22[3]	83,711	11
Undetermined	2	1,200	9

[1]Includes one municipality having two treatment plants, one of which has no project required, and Bettendorf, Iowa, which discharges to Davenport, Iowa.
[2]Includes one municipality having four treatment plants, one of which has no project required.
[3]Includes two municipalities with multiple plants with needs as indicated.

Of the 36 known industrial plants with separate waste outlets, 15 require new waste treatment plants (or outlets to municipal sewerage systems with treatment) and one needs to enlarge its existing plant. All but one of the industries requiring new waste treatment plants or the enlargement of existing facilities are classified under the food and kindred products listing. No satisfactory estimate of the cost of industrial waste treatment facilities needed in this basin is possible since the nature of the wastes will vary widely even within identical industrial groups. It is also realized that certain in-plant changes in equipment, operation, and housekeeping may result in a decrease in the quantity and strength of waste which may markedly decrease the total cost of treatment facilities required.

TABLE H
STATUS OF TREATMENT WORKS PROJECTS TO ABATE POLLUTION
July 1, 1953

Status of Project	Number	
	Municipal	Industrial
Plans under Preparation	9	2
Final Plans Approved	2	0
Under Construction	0	1
Status Undetermined	29	14

Table H presents the currently available information on the status of projects to abate water pollution in this basin. It will be seen that one industry has its treatment facilities under construction, and two municipalities have final plans approved for construction, while nine municipalities and two industries are actively engaged in preparing plans for the needed treatment facilities.

Intensification of State water pollution control educational programs is important to long-range planning and good administration by water pollution control agencies. The undesirable effects of pollution on public health and water conservation must be presented to the public if its support of water pollution control measures is to be expected. Responsible officials, of both municipalities and industries, should become acquainted with expected treatment needs so that the needed improvements can be planned for well ahead of the time when these needs become an actuality and before damage to the waters has occurred.

APPENDIX

TABLE I

BASIC DATA ON SOURCES OF MUNICIPAL* POLLUTION

MISSISSIPPI-WAPSIPINICON & TRIBUTARIES BASIN

Name and Location	Population Served by Sewers	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
			Cap'y.	Opr.			
MISSISSIPPI RIVER:							
Guttenberg, Iowa	1,500	None	--	--	1,500	New Plant	
Cassville, Wis.	650	Primary	Undet.	Sat.	Undet.	Undet.	
Dubuque, Iowa	45,000	None	--	--	250,000	New Plant	Active Planning
East Dubuque, Ill.	1,475	None	--	--	Undet.	New Plant	Plans Approved
Bellevue, Iowa	1,500	None	--	--	1,500	New Plant	
Savanna, Ill.	4,792	Primary	Sat.	Sat.	Undet.	None	
Fulton, Ill.	2,585	None	--	--	Undet.	New Plant	
Clinton, Iowa	25,000	None	--	--	450,000	New Plant	
Camanche, Iowa	640	None	--	--	700	New Plant	
Port Byron, Ill.	861	None	--	--	Undet.	New Plant	

*Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

TABLE I (Cont'd)

Name and Location	Population Served by Sewers	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
			Cap'y.	Opr.			
MISSISSIPPI RIVER (Cont'd.)							
East Moline, Ill.	12,359	None	--	--	Undet.	New Plant	Active Planning
East Moline St. Hosp.		None	--	--	Undet.	New Plant	Active Planning
Moline, Ill.	34,608	None	--	--	Undet.	New Plant	Plans Approved
Davenport, Iowa	66,000	Primary	Unsat.	Sat.	60,000	Enlargement	
Bettendorf, Iowa	4,500	Davenport plant (Primary)				None	
Rock Island, Ill.	42,775	Primary	Sat.	Sat.	Undet.	None	
TURKEY RIVER:							
Calmar, Iowa	300	Secondary	Unsat.	Sat.	200	Replacement	
East Plant	450	Secondary	Unsat.	Sat.	200	Replacement	
West Plant							
Ossian, Iowa	600	Secondary	Sat.	Sat.	150	None	
S.E. Plant	200	Secondary	Sat.	Sat.	100	Replacement[1]	
3 Small Plants							
Elkader, Iowa	1,200	None	--	--	1,200	New Plant	

[1]Replacement by lift station pumping to new plant.

TABLE I (Cont'd)

Name and Location	Population Served by Sewers	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
			Cap'y.	Opr.			
OTTER CREEK OF TURKEY RIVER:							
West Union, Iowa							
South Plant	1,100	Secondary	Sat.	Sat.	200	None	
North Plant	600	Secondary	Unsat.	Sat.	200	Enlargement	
ROBERTS CREEK:							
Monona, Iowa	1,000	Secondary	Unsat.	Sat.	300	Replacement	
VOLGA RIVER:							
Hawkeye, Iowa	400	Primary	Unsat.	Sat.	300	Replacement	
Fayette, Iowa	1,000	Primary	Unsat.	Sat.	1,000	Replacement	
Arlington, Iowa	500	Secondary	Sat.	Sat.	100	None	
Strawberry Point, Iowa							
North Plant	340	Secondary	Unsat.	Unsat.	100	Replacement	Active Planning
GRANT RIVER:							
Fennimore, Wis.	1,000	Secondary	Sat.	Sat.	Undet.	None	
Bloomington, Wis.	550	Primary	Undet.	Undet.	Undet.	Undet.	
Lancaster, Wis.	2,500	Secondary	Sat.	Sat.	Undet.	None	
Grant Co. Hosp. H Home	?	Secondary	Sat.	Sat.	Undet.	None	

TABLE I (Cont'd)

Name and Location	Population Served by Sewers	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
			Cap'y.	Opr.			
PLATTE RIVER, LITTLE PLATTE RIVER:							
Platteville, Wis.	4,500	Secondary	Unsat.	Undet.	Undet.	Enlargement	Active Planning
LITTLE MAQUOKETA RIVER:							
Farley, Iowa	500	Secondary	Unsat.	Sat.	200	Replacement	
GALENA RIVER:							
Shullsburg, Wis.	900	Primary	Unsat.	Sat.	Undet.	New Plant	
Galena, Ill.	4,126	None	--	--	Undet.	New Plant	Active Planning
MAQUOKETA RIVER:							
Strawberry Point, Iowa South Plant	765	Secondary	Unsat.	Unsat.	400	Replacement	Active Planning
Manchester, Iowa	3,500	Secondary	Sat.	Sat.	500	None	
Earlville, Iowa	600	Secondary	Sat.	Sat.	150	None	
Monticello, Iowa	2,300	Secondary	Sat.	Sat.	400	None	
Maquoketa, Iowa	3,200	None	--	--	7,000	New Plant	Active Planning
NORTH FORK-MAQUOKETA RIVER:							
Dyersville, Iowa	2,000	Secondary	Sat.	Sat.	400	None	

TABLE I (Cont'd)

Name and Location	Population Served by Sewers	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
			Cap'y.	Opr.			
NORTH FORK-MAQUOKETA RIVER: (Cont'd.)							
Cascade, Iowa	1,200	Secondary	Sat.	Sat.	600	None	
DEEP CREEK:							
Preston, Iowa	540	Secondary	Unsat.	Sat.	200	Replacement	
APPLE RIVER:							
Elizabeth, Ill.	694	Primary	Sat.	Unsat.	Undet.	None	
Hanover, Ill.	899	None	--	--	Undet.	New Plant	
WOLF CREEK:							
Warren, Ill.	1,119	Secondary	Unsat.	Unsat.	Undet.	Enlargement	
PLUM RIVER, CARROLL CREEK:							
Mount Carroll, Ill.	1,845	None	--	--	Undet.	New Plant	
WAPSIPINICON RIVER:							
Riceville, Iowa	900	Secondary	Unsat.	Sat.	600	Replacement	
Tripoli, Iowa	810	Primary	Unsat.	Unsat.	3,500	Replacement	
Dunkerton, Iowa	300	None	--	--	300	New Plant	

TABLE I (Cont'd)

Name and Location	Population Served by Sewers	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
			Cap'y.	Opr.			
WAPSIPINICON RIVER: (Cont'd.)							
Independence, Iowa	4,000	Secondary	Sat.	Sat.	1,300	None	
Independence St. Hosp.	2,000	Secondary	Unsat.	Sat.	700	Enlargement	
Central City, Iowa	300	Primary	Unsat.	Sat.	400	Replacement	
Anamosa, Iowa	3,700	Secondary	Sat.	Sat.	500	None	
Olin, Iowa	430	None	--	--	730	New Plant	
Oxford Junction, Iowa	300	None	--	--	300	New Plant	
Lost Nation, Iowa	450	Secondary	Sat.	Sat.	100	None	
Grand Mound, Iowa	350	Secondary	Unsat.	Unsat.	100	Replacement	
DeWitt, Iowa	2,200	Secondary	Sat.	Sat.	400	None	
MIDDLE BRANCH:							
Elma, Iowa	650	Secondary	Sat.	Sat.	200	None	
EAST BRANCH:							
New Hampton, Iowa	2,500	Secondary	Unsat.	Sat.	800	Enlargement	
Fredericksburg, Iowa	500	Primary	Unsat.	Unsat.	500	Replacement	Active Planning

TABLE I (Cont'd)

Name and Location	Population Served by Sewers	Waste Treatment Provided	Adequacy of Treatment Facilities		P.E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
			Cap'y.	Opr.			
LITTLE WAPSIPINICON:							
Sumner, Iowa	1,500	Secondary	Sat.	Unsat.	150	None	
OTTER CREEK OF WAPSIPINICON:							
Oelwein, Iowa	7,000	Secondary	Sat.	Sat.	1,500	None	
BUFFALO CREEK:							
Coggon, Iowa	600	Secondary	Sat.	Sat.	200	None	

TABLE 2

BASIC DATA ON SOURCES OF INDUSTRIAL* POLLUTION

MISSISSIPPI-WAPSIPINICON & TRIBUTARIES BASIN

Name and Location	Type of Industry	Type Waste Produced	Treatment or Other Pollution Control Measures			P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Current Status Industrial* Action
			Degree	Adequacy				
				Cap'y.	Opr.			
MISSISSIPPI RIVER:								
Cassville, Wis.								
Cheese Plant	Food	Organic	Undet.			Undet.	Undet.	
Dubuque, Iowa								
Algonquin Chemical Co.	Chemical	Inorganic	None	--	--	--	Undet.	
John Deere Co.	Fab Metal	Inorganic & San. Sew.	Primary	Sat.	Sat.	1,000	None	
Maizewood Insulation Company	Paper & Allied Products	Organic	Undet.	--	--	Undet.	Undet.	
Virginia-Carolina Chem. Corp.	Chemical	Inorganic	None	--	--	--	Undet.	
Dubuque Packing Co.	Food	Organic	None	--	--	Undet.	New Plant	
Clinton, Iowa								
Central Steel Tube Co.	Fab Metals	Inorganic	None	--	--	--	Undet.	
Clinton Industries	Food	Organic	None	--	--	400,000	New Plant	
Pillsbury Mills	Food	Organic	None	--	--	20,000	New Plant	
Dupont Company	Chemical	Organic & Inorganic	Primary	Undet.	Undet.	Undet.	Undet.	
Swift & Company	Food	Organic	None	--	--	Undet.	New Plant	

*Industries having separate outlets and discharging wastes directly to watercourse.

TABLE 2 (Cont'd.)

Name and Location	Type of Industry	Type Waste Produced	Treatment or Other Pollution Control Measures			P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Current Status Industrial* Action
			Degree	Adequacy				
				Cap'y.	Opr.			
MISSISSIPPI RIVER: (Cont'd.)								
Davenport, Iowa								
Aluminum Co. of America (sanitary plant)	Fab Metals	Organic	Secondary	Sat.	Sat.	1,000	None	
Aluminum Co. of America (proc. plant)	Fab Metals	Inorganic	Inter.	Sat.	Sat.	-- --	None	
TURKEY RIVER:								
Castalia, Iowa								
Carnation Milk Sta.	Food	Organic	Secondary	Unsat.	Sat.	200	Enlargement	
Elgin, Iowa								
Cannery	Food	Organic	Irrigation	Sat.	Sat.	None	None	
Creamery	Food	Organic	None	--	--	Undet.	New Plant	
LITTLE TURKEY RIVER, CRANE CREEK:								
Alpha, Iowa								
Alpha Rendering Plant	Food	Organic	None	--	--	Undet.	New Plant	Act. Planning
ROBERTS CREEK:								
Luana, Iowa								
Luana Dairy	Food	Organic	Undet.			Undet.	Undet.	

TABLE 2 (Cont'd.)

Name and Location	Type of Industry	Type Waste Produced	Treatment or Other Pollution Control Measures			P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Current Status Industrial* Action
			Degree	Adequacy				
				Cap'y.	Opr.			
GRANT RIVER:								
Patch Grove, Wis.								
Dairy	Food	Organic	None	--	--	Undet.	New Plant	
Potosi, Wis.								
Brewery	Food	Organic	None	--	--	Undet.	New Plant	
PLATTE RIVER:								
Arthur, Wis.								
Cheese & Butter Plt.	Food	Organic	Secondary	Sat.	Unsat.	Undet.	None	
Louisberg, Wis.								
Creamery	Food	Organic	None	--	--	Undet.	New Plant	
GALENA RIVER:								
Shullsburg, Wis.								
Calumet-Hecla Mining Co.	Mining	Inorganic	Primary	Sat.	Sat.	--	None	
Vinegar Hill Mining Co.	Mining	Inorganic	Primary	Sat.	Sat.	--	None	
Galena, Ill.								
Eagle Pitcher Co.	Metals	Inorganic	Primary	Sat.	Sat.	--	None	
Tri-State Zinc Co.	Metals	Inorganic	Primary	Sat.	[illegible]	--	None	

TABLE 2 (Cont'd.)

Name and Location	Type of Industry	Type Waste Produced	Treatment or Other Pollution Control Measures			P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Current Status Industrial* Action
			Degree	Adequacy				
				Cap'y.	Opr.			
MAQUOKETA RIVER:								
Langworthy, Iowa Langworthy Creamery	Food	Organic	None	--	--	Undet.	New Plant	
NORTH FORK, MAQUOKETA, WHITE WATER CREEK:								
Epworth, Iowa Creamery	Food	Organic	None	--	--	Undet.	Undet.	
APPLE RIVER:								
Hanover, Ill. Hanover Woolen Mills	Textile	Organic & Inorganic	None	--	--	Undet.	Undet.	
PLUM RIVER, CARROLL CREEK:								
Stockton, Ill. Atwood Vacuum Mach. Co.	Fab Metal	Inorganic	Secondary	Sat.	Sat.	--	None	
Lanark, Ill. Lanark-Minn. Valley Canning Co.	Food	Organic	Secondary	Sat.	Sat.	Undet.	None	

TABLE 2 (Cont'd.)

Name and Location	Type of Industry	Type Waste Produced	Treatment or Other Pollution Control Measures			P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Current Status Industrial* Action
			Degree	Adequacy				
				Cap'y.	Opr.			
WAPSIPINICON RIVER:								
Riceville, Iowa Riceville Creamery	Food	Organic	None	--	--	100	New Plant	
MIDDLE BRANCH:								
Alta Vista, Iowa Alta Vista Creamery	Food	Organic	None	--	--	600	New Plant	
EAST BRANCH:								
Fredericksburg, Iowa Fredericksburg Creamery	Food	Organic	None	--	--	400	New Plant	
OTTER CREEK:								
Oelwein, Iowa Railroad Yard	Misc.	Inorganic	None	--	--	--	New Plant	Under Const.
Hazelton, Iowa Hazelton Cheese Fact.	Food	Organic	None	--	--	400	New Plant	Act. Planning

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